ON SITE GROUNDWATER INVESTIGATION REPORT

HARDESTY FEDERAL COMPLEX
601-607 HARDESTY AVENUE
KANSAS CITY, JACKSON COUNTY, MISSOURI

EPA ID No. MON000703320

Terracon Project No. 02037021
August 20, 2003

Prepared for:

UNITED STATES GENERAL SERVICES ADMINISTRATION
Kansas City, Missouri

Prepared by:

Terracon
Lenexa, Kansas

August 20, 2003

United States General Services Administration
1500 East Bannister Road
Kansas City, Missouri 64131-3088

Attn: Mr. Dave L. Hartshorn (6 PEC-F)

Re: On Site Groundwater Investigation Report
Hardesty Federal Complex
601-607 Hardesty Avenue
Kansas City, Jackson County, Missouri 64116
EPA Region 7
EPA ID No. MON000703320
Terracon Project No. 02037021

Dear Mr. Hartshorn:

Terracon is pleased to submit two copies of the On Site Groundwater Investigation Report for the above referenced property. This investigation was performed in general accordance with our proposal dated April 21, 2003. The additional environmental site investigation (ESI) activities were based on the results of Terracon's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Preliminary Assessment (PA) report dated November 4, 2002, and Terracon's Expanded CERCLA Site Inspection (SI) report dated November 4, 2002 for the above-referenced site. Terracon conducted the operations described in the following report to address the contamination identified during the SI activities at the subject site that may be associated with historical clothing chemical pretreatment activities.

We appreciate the opportunity to perform these services for you. If you have any questions regarding this information, or if we can be of further assistance, please contact us at (913) 492-7777.

Sincerely,
Terracon

Carrie A. Stull.
Environmental Geologist

Eric J. Gorman, CHMM, P.G.
Environmental Due Diligence Manager

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HARDESTY FEDERAL COMPLEX
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KANSAS CITY, JACKSON COUNTY, MISSOURI

Terracon Project No. 02037021
August 20, 2003

1.0 INTRODUCTION

Terracon has conducted additional environmental site investigation (ESI) activities at the Hardesty Federal Complex in Kansas City, Jackson County, Missouri in general accordance with our proposal dated April 21, 2003. The Missouri Department of Natural Resources (MDNR) approved our proposal with modifications, requesting two of the deeper wells be advanced to 70 feet below ground surface (bgs) in an attempt to determine depth to bedrock. This investigation was based on the results of Terracon's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Preliminary Assessment (PA) report dated November 4, 2002, and Terracon's Expanded CERCLA Site Inspection (SI) report dated November 4, 2002 for the above-referenced site.

The purpose of these site investigation activities is to evaluate the lateral and vertical extent of chlorinated VOCs impact to on-site groundwater. Groundwater samples collected during the SI activities had detected concentrations of VOCs above MDNR levels in the vicinity of Building 6, the former clothing chemical pretreatment building.

1.1 Site Description

The total area of the Hardesty Federal Complex is approximately 18 acres, and is irregular in shape. The Hardesty Federal Complex property is located on relatively flat terrain that slopes gently toward the east\southeast property boundary (**Figure 1**). The U.S. Government Services Administration (GSA) currently owns the subject site.

1.2 Operational History

A brief review of operational history and waste characteristics of Building 6, associated with historical clothing chemical pretreatment activities. Refer to Terracon's CERCLA PA report, dated November 4, 2002, and Terracon's CERCLA SI report, dated November 4, 2002 for further detailed information regarding operational history and waste characteristics of Building 6, the subject site, and remaining site structures.

Building 6:

- Building 6 was originally constructed as a clothing treatment/renovation plant as part of the Chemical Warfare Service Project, operated by the Chemical Warfare Service. The purpose of the project was to treat new Army uniforms with "Impregnate I" to make them gas-resistant against chemicals such as "mustard gas." Old uniforms were to be laundered and then treated with "Impregnate I."

- The following additional structures associated with the clothing treatment/renovation plant were formerly located south of Building 6, in an area currently grass-covered: a cooling tower, two pump houses, two storage tanks, and a recovery tank. It is unknown if these structures were located aboveground or underground. One of the pump houses was identified as Building 14 in a diagram dated December 1979. Information obtained from a Phase I Environmental Site Assessment (ESA) report of the Hardesty Federal Center, prepared by Terracon, dated August 19, 1999, indicated that two or three open concrete underground rooms may have been formerly located in the grassy area to the south of Building 6. These rooms were reportedly never used for their intended purpose as holding tanks for the clothing treatment process, and were filled with sand several years ago.

- According to the December 1979 site diagram, an existing concrete pit, 33 feet long, 14 feet wide, and 5 feet 8 inches deep, was located in the current-day grassy area along the southern exterior side of Building 6. The site diagram indicated that the floor in this pit was to be broken through in four places for drainage, that the existing concrete tank supports were to remain, and that the pit was to be filled. The pit was filled with sand or soil according to interviewee information obtained from Terracon's Phase I ESA report dated August 19, 1999. Another existing concrete pit, 14 feet long, 14 feet wide, and 3 feet deep, was located approximately 40 feet south of Building 6 in the current-day grassy area. The site diagram indicated that the walls and pedestals of this pit were to be demolished to 2 feet below finish grade. The site diagram also indicated that five concrete tank supports were to be demolished to 2 feet below finish grade and that the slab was to be broken at five locations. These tank supports were depicted along the southern exterior wall of Building 6. Depressions observed in the ground surface in this area during the Terracon site visits in 1999 and 2001 appear to correspond to locations on site diagrams showing the recovery tank and holding tank structures. Waste characteristics, if any, associated with the clothing treatment/renovation plant could not be documented or verified during the preparation of the PA.

1.3 Background

Terracon's PA was based on a visual survey of the subject site, a reconnaissance of adjoining properties, interviews with individuals knowledgeable about the subject site, a regulatory records review, project-specific research, review of subsequent documents provided by GSA in 2002 and a review of site use history. The SI was conducted on the basis of PA findings.

According to Terracon's SI report, dated November 4, 2002, Terracon collected on-site groundwater samples during three sampling events, February 2002, June/July 2002, and October 2002. Terracon concluded the following:

- The highest area of groundwater concentration of VOCs appears to be in the grass-covered area between Buildings 6 and 9, and toward the northeast, east, and southeast of the grass-covered area. Since VOCs have also been detected in probes advanced within approximately 25 feet of the north and east perimeter boundaries of the subject site, it appears that VOC contaminants have reached the boundary of the subject site, and may extend beyond the boundaries of the Hardesty Federal Complex to the north and east. VOCs above the MDNR GTARC CALM were not detected to the west of the grass-covered area.

- Based on information obtained from Terracon's Phase I ESA report dated August 19, 1999, and Terracon's PA report dated November 4, 2002 of the site, it is possible that the source of the VOC contaminants may be associated with historical clothing chemical pretreatment activities that occurred at the site during World War II. VOC contaminants such as PCA, PCE, TCA, TCE, and cis-DCE can typically be associated with the use of dry-cleaning agents. The use of dry-cleaning agents was one of the functions of the Hardesty Federal Complex during its use a Quartermaster Depot. The treatment/renovation of new Army uniforms with "Impregnate I" to make them gas-resistant against chemicals such as "mustard gas," and the laundering of old uniforms, may have involved the use of dry-cleaning agents.

2.0 SERVICES PERFORMED

The purpose of the investigation activities was to evaluate the lateral and vertical extent of chlorinated volatile organic compounds (VOCs) impact to on-site groundwater. Phase I (On-site Groundwater Investigation) of investigation activities were completed as follows:

- Installation and sampling of five permanent groundwater monitoring well clusters (one shallow and one deep) in the vicinity of Building 6, and along the northern site boundary; and,
- Sampling two of the existing monitoring wells installed at the site by Cape Environmental Management, Inc. (originally installed for the purpose of monitoring and characterizing of petroleum-hydrocarbon contamination associated with former underground storage tanks (USTs) previously located at the site).

Phase II (Off-site Groundwater Investigation) will be completed based on results of these on-site groundwater sampling activities.

2.1 Pre-inspection Activities

Terracon contacted Missouri One-Call and met with utility locators at the site on May 30, 2003 to verify that underground utility lines were marked prior to any advancement of borings.

2.2 Soil Boring Installation

Between June 3 and June 10, 2003, a total of five 2-well cluster soil borings/monitor wells were installed on-site. One soil boring/monitoring well cluster was installed south of Building 6, in the vicinity of the former waste solvent tank location. One soil boring/monitoring well cluster was installed approximately 190 feet east of Building 6, and the remaining three soil borings/monitoring well clusters were distributed along the northern site boundary to assess whether the VOC impacted groundwater has migrated offsite to the north. The shallow and deep soil borings were installed adjacent and within approximately ten feet of each other to better assess the potential presence of chlorinated VOCs at varying depths. The soil boring/monitoring well cluster locations are depicted on **Figure 2** that is provided in Appendix A.

The soil borings were installed utilizing a truck-mounted drilling rig under the supervision of a State of Missouri licensed monitoring well driller. The shallow soil borings/monitoring wells in each cluster were installed to a maximum depth of approximately 55 feet bgs. MDNR requested that two borings be advanced to 70 feet bgs to determine depth to bedrock. One boring (CMW-1D) was advanced to 90 feet bgs, however, bedrock was not encountered.

Sampling and drilling equipment was decontaminated by high pressure cleaning prior to commencement of the project, and following installation of each soil boring.

Soil samples were continuously collected from one soil boring/monitoring well from each cluster, during the installation, using split-spoon samplers to document lithology, color, relative moisture content and visual or olfactory evidence of organics. In addition, the samples were scanned with a photoionization detector (PID) for the presence of VOCs. After documentation of lithology of one of the soil boring/monitoring wells, the adjacent soil boring/monitoring well in the cluster was installed without the collection of soil samples. Due to the presence of saturated sands encountered at an approximate depth of 50 to 60 feet bgs across the site, soil sampling activities were stopped prior to encountering the sands. The sands, because they were saturated, would push up into the augers and did not allow for the collection of a soil sample. Nor installation of the monitoring well. Boring logs are provided in Appendix C.

The ten (10) soil borings were converted to permanent groundwater monitoring wells to evaluate groundwater on the site. The monitoring wells were completed as follows:

- Installation of 5 to 15 feet of 2-inch diameter, machine slotted PVC well screen assembly with a threaded bottom plug;
- Installation of riser pipe to surface;
- Addition of graded silica sand for annular sand pack around the well screen from the bottom of the well to 2 feet above the top of the screen;
- Placement of 2 feet of hydrated bentonite pellets above the sand pack;
- Placement of between 6 and 48 feet of bentonite chips to the surface, and set the well cover in a concrete base; and
- Installation of a locking well cap and circular, bolt-down, flush mount well cover.

The monitoring wells were developed by utilizing a pump. Drill cuttings and development groundwater were stored on-site in labeled 55-gallon, Department of Transportation (DOT) approved drums.

2.3 Surveying

Terracon subcontracted with a State of Missouri licensed surveyor to survey the location and elevation of 10 newly installed monitoring wells and two existing monitoring wells (MW6 and MWX) previously installed at the site by Cape Environmental Management, Inc. The monitoring well elevations were surveyed into the Missouri State Plane Coordinated System, and elevations were recorded as feet above mean sea level. The monitoring well elevations are provided in **Table 1** that is provided in Appendix B.

2.4 Groundwater Sampling

Groundwater sampling activities were conducted on June 14, 2003. One groundwater sample was collected from each monitoring well utilizing a dedicated disposable bailer. Prior to groundwater sampling, the monitoring wells were purged of three well volumes.

The soil and groundwater samples were placed in laboratory prepared glassware, labeled and stored with ice in a cooler. The samples were transported to Test America, Inc., in Nashville, Tennessee using standard chain-of-custody procedures.

Terracon also sampled two existing monitoring wells MW6 and MWX previously installed at the site by Cape Environmental Management, Inc. These wells were originally installed for the purpose of monitoring and characterization of petroleum-hydrocarbon contamination associated with former USTs previously located at the site.

3.0 SAMPLING PROGRAM

Terracon's soil and groundwater sampling program consisted of the following:

- One or two soil samples were collected from one representative soil boring from each well cluster, based on the field sampling professional's judgement; from zones exhibiting the highest concentration of VOCs (using visual, olfactory or PID evidence); from the capillary fringe zone; or from a change in lithology.

- One groundwater sample was collected from each of the 10 newly installed monitoring wells using a dedicated disposable bailer. The monitor wells were purged, as previously described, prior to sample collection. Groundwater samples were collected in 40-milliliter (ml) septumed laboratory-provided glass vials and preserved with hydrochloric acid (HCl).

- One groundwater sample was collected from monitoring wells MW6 and MWX, previously installed at the site by Cape Environmental Management, Inc, utilizing a dedicated disposable bailer. Groundwater samples were collected in 40-ml septumed laboratory-provided glass vials and preserved with HCl.

4.0 ANALYTICAL PROCEDURES

Terracon collected, preserved, and submitted 10 soil samples (soil samples from one representative soil boring from each cluster and one duplicate soil sample) and 13 groundwater samples (one groundwater sample from each of the 12 monitoring wells and one duplicate for analysis). In addition to these samples, two trip blanks, one rinsate sample, and one field blank were submitted to Test America, Inc., in Nashville, Tennessee via standard chain-of-custody procedures. These soil and groundwater samples were submitted for VOCs analysis utilizing USEPA SW-846 Method 8260B.

4.1 Quality Assurance/Quality Control

Quality assurance and quality control (QA/QC) for this sampling event was provided by a combination of field blanks, rinsates, field duplicates, and trip blanks.

To test the reliability of sampling procedures and results, one duplicate soil sample and one duplicate groundwater sample were collected. One (1) field blank sample was collected during groundwater sampling activities to evaluate the potential for contamination introduced by sample containers and preservatives. One (1) trip blank sample was also included in each of the two sample coolers to be tested for VOCs, to evaluate potential contamination from sample cross-contamination introduced during collection, shipping, and storage of samples. One (1) rinsate sample was collected during soil sampling activities.

Sample collection, preservation, and chain-of-custody procedures used during sampling activities were in general accordance with Terracon's Standard Operating Procedures (SOPs) as included in Terracon's SI Workplan, *Hardesty Federal Complex, 601-607 Hardesty Avenue, Kansas City, Jackson County, Missouri*, dated February 4, 2002.

Field blanks: Deionized water was poured into the appropriate sample containers to be analyzed for VOCs. The field blank was prepared during the on-site groundwater sampling activities.

- No VOCs were detected in the field blank sample.

Field duplicates: One duplicate soil sample and one duplicate groundwater sample were collected during the installation and sampling of the ten permanent monitoring wells. The duplicate samples were collected in the appropriate sample containers and analyzed for the same sample parameters as the sample it was intended to duplicate. Soil sample B7B (15'-20') was collected as a duplicate sample of B7A (15'-20'); which was collected from CMW-4S. Groundwater sample Duplicate (a) was collected as a duplicate sample of CMW-5D.

- In comparing the analytical results of the samples and their duplicate samples, it does not appear that there are significant variances in the detected concentrations; verifying consistency in the laboratory procedure and equipment.

Trip blanks: Trip blanks were provided by the VOC laboratory. The bottles containing the trip blanks were sealed by the laboratory and placed in the appropriate coolers for transport to the site. The trip blanks were then sent back to the laboratory, along with the coolers which contained the water samples collected, and analyzed for the same sample parameters as the water samples.

- No VOCs were detected in the two trip blank samples. Based on the analytical results of the two trip blank samples submitted with the sample coolers, it does not appear that cross contamination has occurred.

Rinsate: Deionized water was poured over equipment used during the installation of the ten permanent monitoring wells, into the appropriate sample containers to be analyzed for VOCs.

- Two VOCs were detected in the rinsate sampled collected on June 10, 2003 during the soil sampling activities, including methylene chloride and toluene. Methylene chloride is a common laboratory contaminant and was not detected in either of the 10 soil samples analyzed. Toluene was detected in one soil sample B4 (28.5-30), collected on June 9, 2003. Based on these results, it appears that the decontamination procedures at the site were completed appropriately.

5.0 DATA EVALUATION

5.1 Geology

Jackson County is located near the middle of an approximate 150-mile wide, north-south trending band of Pennsylvanian Age rocks that is located in western Missouri and eastern Kansas. Generally, the rock beds exhibit a subtle prevailing dip to the west-northwest. A prominent section of Pennsylvanian rock strata is well-exposed in Kansas City, Missouri, in the bluffs along the Missouri River. According to The Stratigraphic Succession in Missouri, Missouri Department of Natural Resources (revised in 1995), the region is underlain by rock units of the Pennsylvanian System and the Missourian Series (Kansas City Group and Pleasanton Group) in the Time Stratigraphic Unit age classification. Alternating layers of shales and limestone, with an occasional sandstone layer, are common in the Kansas City Group. Alternating layers of shale and sandstone, with an occasional coal seam and limestone layer, are present in the Pleasanton Group.

During monitoring well installation activities, Terracon encountered lean clays with silt to approximately 25 to 30 feet bgs, followed by silt between approximately 25 to 37 feet bgs, with sand between approximately 45 to 90 feet bgs. Based on the soils encountered during the field activities, a distinct confining unit was not identified. Additionally, no aquacludes (a geologic unit preventing vertical groundwater migration) appeared to be present. Figures 5 through 7 present cross sections of the subject site. Soil borings are provided in Appendix C.

5.2 Hydrogeology

Jackson County is located in the Saline Groundwater Province. In the upland areas above the alluvial valleys of the Missouri River, the Blue River, and the Little Blue River, the unconsolidated sediment is typically deficient of groundwater. Additionally, some unconfined aquifers are present at the interface of glacial outwash and underlying shales, but the quality and quantity is not adequate for drinking water purposes. Almost one-third of the state of Missouri is underlain by bedrock aquifers that contain saline water. Saline water is groundwater that contains 1,000 ppm or more of dissolved solids. The County is underlain by bedrock aquifers at depths of 250 to 400 feet that contain saline water which coincide with the presence of Pennsylvanian rocks. Total thickness of the aquifer ranges from 1,200 to more than 4,000 feet. Because Jackson County is located in the Saline Groundwater Province, the domestic water supply for the area of the Hardesty Federal Complex is from the alluvium of the Missouri River. The Missouri River alluvial aquifer is located in the flood plain of the Missouri River and varies from 40 to 100 feet bgs. There is no potable water aquifer south of the Missouri River in the area of the Hardesty Federal Complex.

5.3 Groundwater Gradient

Based on the groundwater levels measured on July 3, 2003 from monitoring wells CMW-1s, CMW-1d, CMW-2s, CMW-2d, CMW-3s, CMW-3d, CMW-4s, CMW-4d, CMW-5s, CMW-5d, MW6, and MWX, the depth to groundwater ranges from approximately 13.55 feet bgs to approximately 22.38 feet bgs. Groundwater elevations are provided in **Table 2** that is provided in Appendix B. Figures 5 through 7 present cross sections of the subject site. These cross sections also show groundwater elevations measured at the site.

A confining unit was not observed during the drilling of the monitoring wells. It appears that deeper wells are screened in a portion of the aquifer which may have different transmissivity values than that of the shallow screened wells. The groundwater gradient for the subject site appears to flow toward the east-northeast, with some possible flow to the southeast following site topographic gradient. Groundwater elevations for the shallow monitoring wells installed are provided in **Figure 3**, and groundwater elevations for the deep monitoring wells installed are provided in **Figure 4**, which are provided in Appendix A.

5.4 Soil Analytical Results

Terracon submitted 10 soil samples, which included one (1) duplicate soil sample (sample B7B (15-20)), to Test America, Inc., to be analyzed for VOCs utilizing USEPA SW-846 Method 8260B. Terracon also submitted a trip blank sample, and a rinsate sample to be analyzed for VOCs utilizing USEPA SW-846 Method 8260B. The laboratory analytical concentrations identified in the soil samples were compared to the Missouri Department of Natural Resources (MDNR) Cleanup Levels for Missouri (CALM) Soil Target Concentrations (STARC), Scenario A, and the MDNR, CALM, Leaching to Groundwater Values (Groundwater Leach), dated September 1, 2001. Laboratory results are summarized in **Table 3**, in Appendix B, and the laboratory reports are provided in Appendix D.

The data evaluation for the soil samples of this investigation is as follows:

- 17 VOCs were detected above the laboratory detection limits from the 10 soil samples collected. Trichloroethene (TCE), 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and total xylenes were detected most frequently with three (3) to four (4) detection's each.
- Only two VOCs (1,1,2,2-tetrachloroethane (PCA) and TCE) were detected above MDNR CALM STARC or Groundwater Leach levels. Both were detected in B9 at a depth of 25-30 feet bgs. PCA was detected at 50.5 mg/kg, which is above the MDNR CALM STARC level of 2 mg/kg and above the Groundwater Leach level of 0.004 mg/kg. TCE, detected at 25.6 mg/kg, was detected above the MDNR CALM Groundwater Leach level of 0.1 mg/kg, but below the MDNR CALM STARC level of 40 mg/kg. B9 (25'-30') is below the static water level for this well and does not represent an accurate soil detection. The soil sample from B9 was collected from the 25-30 foot interval based on elevated PID readings.

5.5 Groundwater Analytical Results

Terracon submitted 13 groundwater samples, which included one (1) duplicate groundwater sample (collected from CMW-5D), to Test America, Inc., to be analyzed for VOCs utilizing

USEPA SW-846 Method 8260B. Terracon also submitted a trip blank and a field blank sample, to be analyzed for VOCs utilizing USEPA SW-846 Method 8260B. The laboratory analytical concentrations identified in the groundwater samples were compared to the Missouri Department of Natural Resources (MDNR) Cleanup Levels for Missouri (CALM) Groundwater Target Concentrations (GTARC), dated September 1, 2001.

The data evaluation for the groundwater samples of this limited investigation is as follows:

- 16 VOCs were detected above the laboratory detection limits from the 13 groundwater samples collected. Cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), 1,1,2,2-tetrachloroethane (PCA), tetrachloroethene (PCE), 1,1,2-trichloroethane (TCA), and TCE were detected most frequently with four (4) to twelve (12) detections each.
- Six (6) VOCs were detected above MDNR CALM GTARC levels, which included 1,1-dichloroethene, PCA, PCE, TCA, TCE, and vinyl chloride. The GTARC action levels are as follows: 0.007 milligrams/liter (mg/l) for 1,1-dichloroethene, 0.0003 for PCA, 0.005 for PCE, 0.005 for TCA, 0.005 for TCE, and 0.002 for vinyl chloride.
- Of the VOCs detected above MDNR CALM GTARC levels, PCA and TCE were detected most frequently across the site ranging from 0.00100 mg/l to 25.6 mg/l for PCA, and 0.0112 mg/l to 12.3 mg/l for TCE.
- Monitoring wells CMW-5s and CMW-5d had the most compounds detected above the MDNR CALM GTARC levels.

Figures 8 through 11 are concentration maps for PCA and TCE detected in the shallow and deep screened monitoring wells.

6.0 FINDINGS AND RECOMMENDATIONS

Based on the results of this on site groundwater investigation, the conclusions and recommendations of this investigation are as follows:

- 1,1 Dichloroethene, PCA, PCE, TCA, TCE, and vinyl chloride were detected above the MDNR CALM GTARC levels. PCA and TCE appear to be the two constituents detected the most frequently in the groundwater samples collected.

- CMW-5s appears to have the highest concentrations of PCE at 50.5 mg/kg in the soil sample collected, and 25.6 mg/l in the groundwater sample collected. CMW-5s also appears to have the highest concentrations of TCE at 25.6 mg/kg in the soil sample collected, and 12.3 mg/l in the groundwater sample collected. However, the soil samples were collected below the static groundwater table and are not representative soil samples.

- The groundwater at the site appears to principally flow toward the east and northeast. Based on laboratory analytical results, it appears likely that VOCs have migrated off-site to the northeast.

- Soil samples collected above the groundwater table do not appear to be impacted above the MDNR CALM STARC and Leaching to Groundwater Values.

- Bedrock was not encountered within 90 feet of ground surface at the site.

- The water levels (and associated groundwater elevations) in the deeper wells were slightly higher than the adjacent shallow wells, which may be indicative of differences in transmissivities within the aquifer, since a confining unit was not observed.

The VOCs detected at the site are dense nonaqueous phase liquids (DNAPLs). These DNAPLs have a higher density than water and will tend to sink through the aquifer over time as well as spread horizontally. In analyzing the concentrations detected across the site, it is apparent that the VOCs detected in groundwater are following a known breakdown pathway for the VOCs present [PCA (and possibly PCE) $\rightarrow$ TCE/TCA $\rightarrow$ cis/trans 1, 2-DCE $\rightarrow$ vinyl chloride].

Additionally, it appears that the VOCs are dropping in elevation across the site to the northeast as evidenced by the increase in TCE concentrations in the deeper of the wells present at well clusters 2 and 3.

Based on the results of this investigation, Terracon recommends that off-site groundwater investigation activities be performed to assess the lateral extent of impact to the north and northeast of the subject site.

7.0 LIMITATIONS

Terracon's services were performed in a manner consistent with generally accepted practices of the profession undertaken in similar studies in the same geographical area during the same time period. Terracon makes no warranties, either express or implied, regarding the findings, conclusions or recommendations.

Findings, conclusions and recommendations resulting from these services are based upon information derived from the most recent on-site activities and other services performed under this scope of work; such information is subject to change over time. Certain indicators of the presence of hazardous substances, petroleum products, or other constituents may have been latent, inaccessible, unobservable, non-detectable or not present during these services, and we cannot represent that the site contains no hazardous substances, toxic materials, petroleum products, or other latent conditions beyond those identified during this assessment. Subsurface conditions may vary from those encountered at specific sampling locations or wells or during other surveys, tests, assessments, investigations or exploratory services; the data, interpretations, and our recommendations are based solely upon data obtained at the time and within the scope of these services.

This report has been prepared for the exclusive use and reliance of the GSA. Use or reliance by any other party is prohibited without the written authorization of the GSA, and Terracon. The limitation of liability defined in the Agreement for Services is the aggregate limit of Terracon's liability to the client and all relying parties.

APPENDIX A

Figures

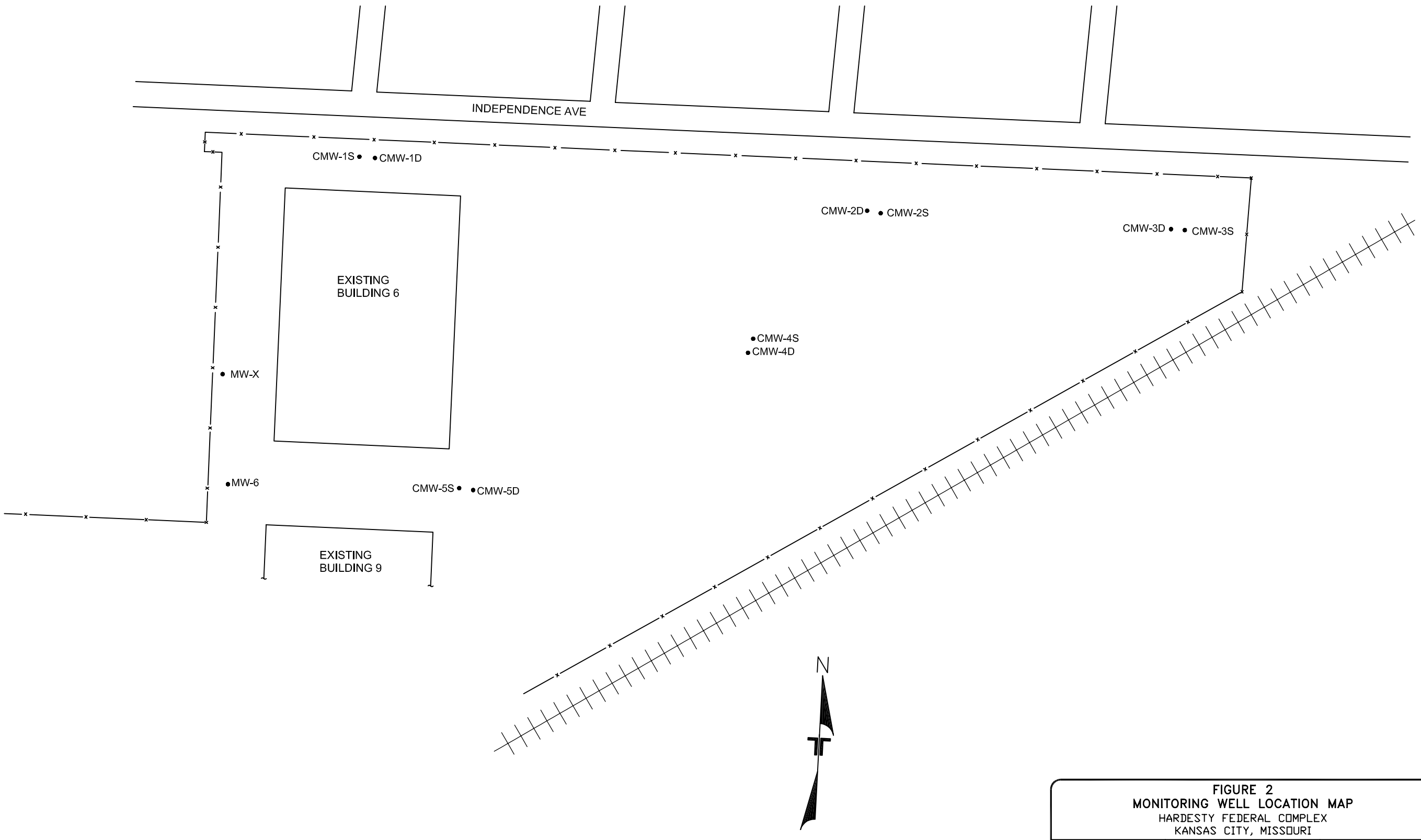
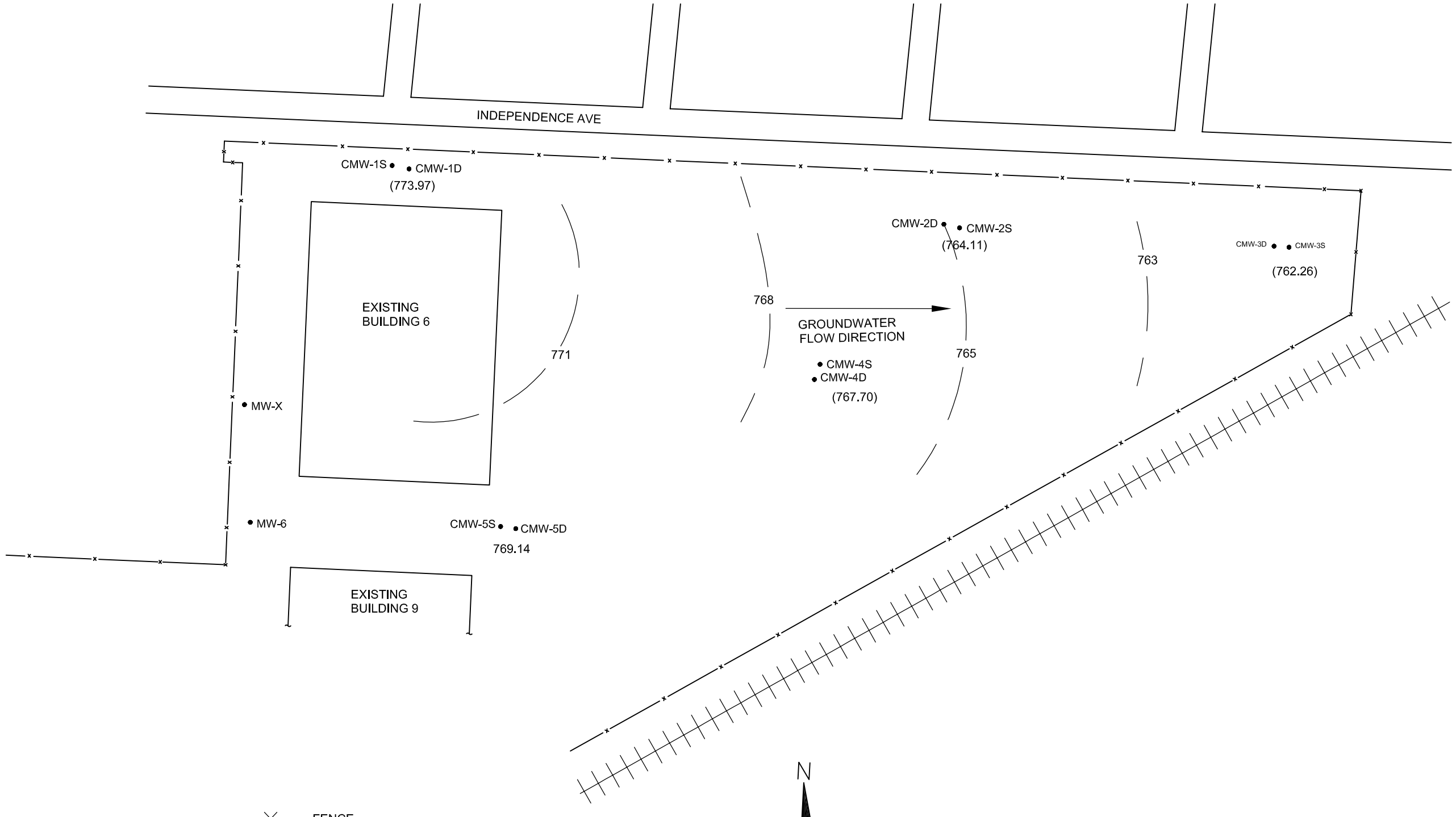


DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 2
MONITORING WELL LOCATION MAP
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr: EJG	Terracon	Project No.	02037021
Designed By: TAR		Scale:	1"=80'
Checked By: CAS	13910 WEST 96th TERRACE	Date:	7/23/03
Approved By: EJG	LENEXA, KANSAS 66215	Drawn By:	SAG
File Name: FIGURE 2.DWG		Figure No.	2



(SHALLOW SCREENED WELLS)

DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 3
GROUNDWATER ELEVATION MAP 7/3/03
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr:	EJG	Terracon	Project No. 02037021
Designed By:	TAR		Scale: 1"=80'
Checked By:	CAS	13910 WEST 96th TERRACE LENEXA, KANSAS 66215	Date: 7/23/03
Approved By:	EJG		Drawn By: SAG
File Name:	FIGURE 3.DWG		Figure No. 3

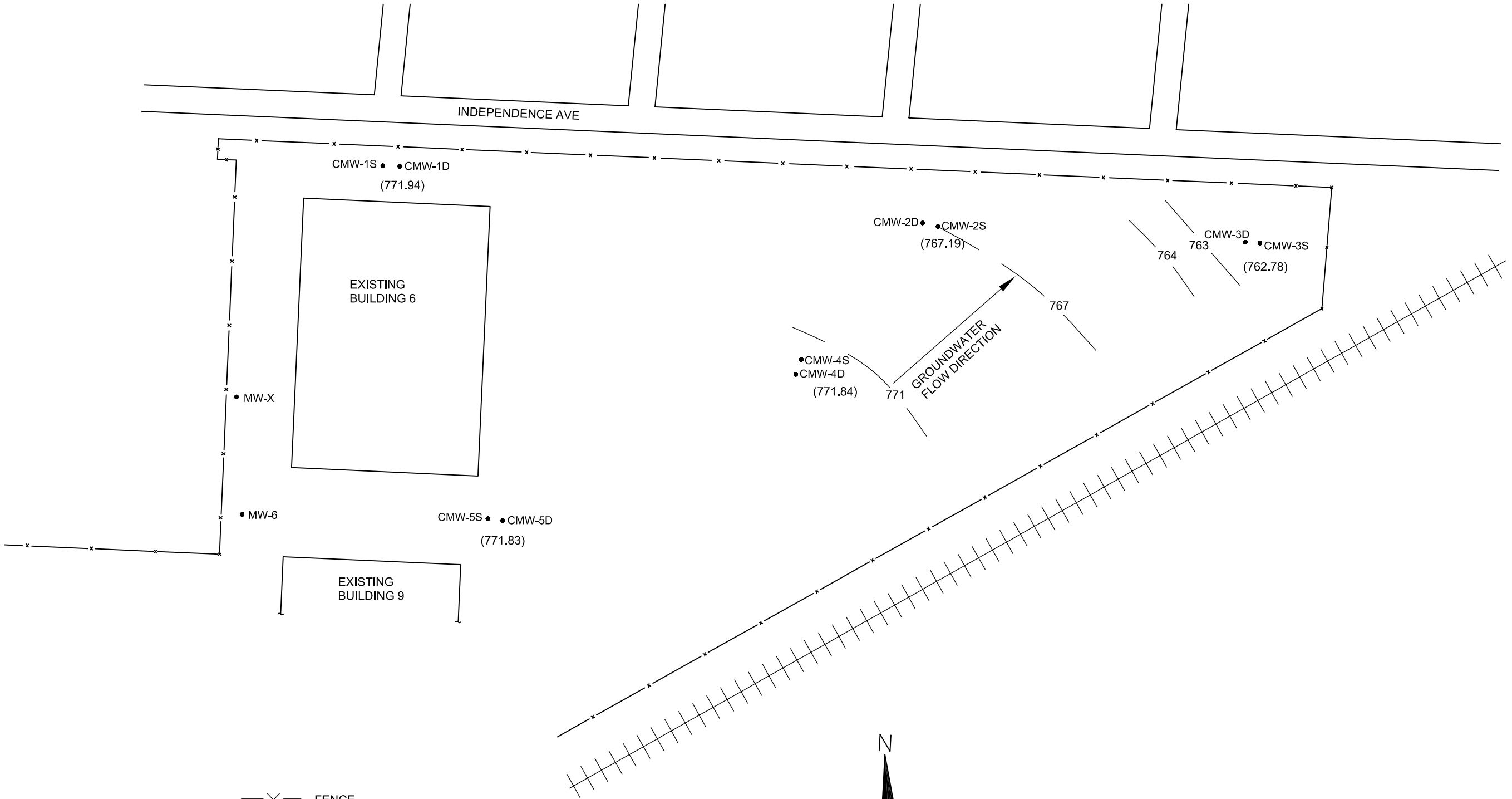


DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

(DEEPER SCREENED WELLS)

FIGURE 4
GROUNDWATER ELEVATION MAP
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr: EJG	Terracon	Project No.	02037021
Designed By: TAR		Scale:	1"=80'
Checked By: CAS	13910 WEST 96th TERRACE	Date:	7/23/03
Approved By: EJG	LENEXA, KANSAS 66215	Drawn By:	SAG
File Name: FIGURE 4.DWG		Figure No.	4

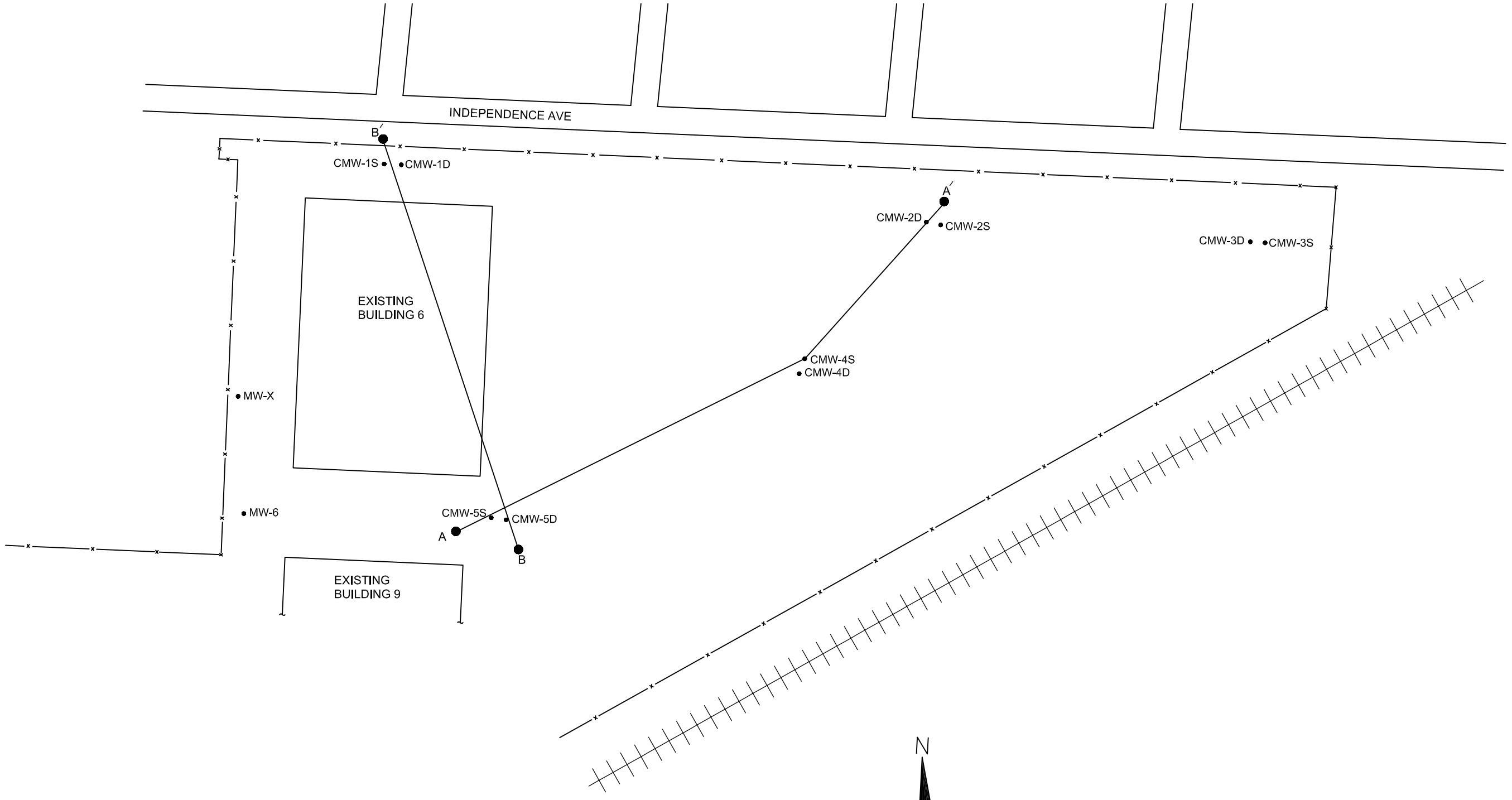
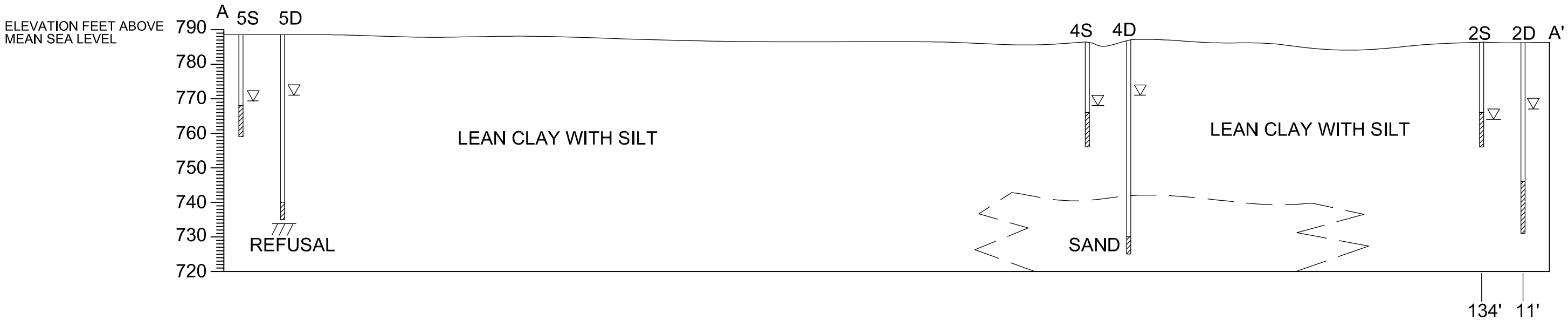


DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 5
CROSS SECTION MAP
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr: EJG	Terracon	Project No.	02037021
Designed By: TAR		Scale:	1"=80'
Checked By: CAS	13910 WEST 96th TERRACE LENEXA, KANSAS 66215	Date:	7/23/03
Approved By: EJG		Drawn By:	SAG
File Name: FIGURE 5.DWG		Figure No.	5



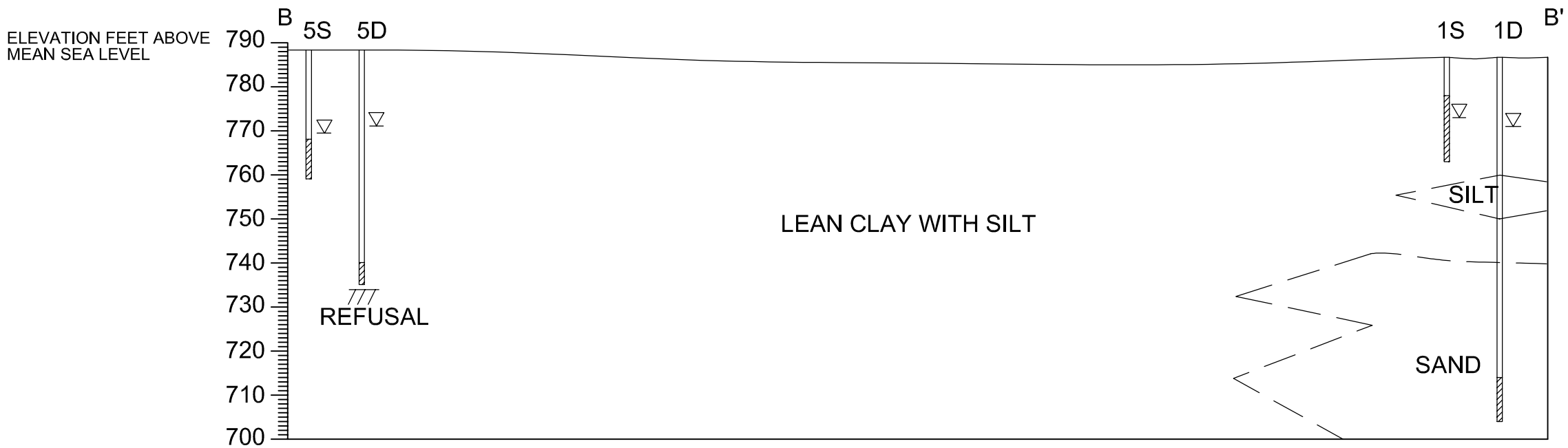
▽ WATER TABLE ELEVATION DATA COLLECTED 7/3/03

SCREENED PORTION OF MONITORING WELL

DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 6
CROSS SECTION A–A'
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr: EJG	Terracon		Project No. 02037021
Designed By: TAR			Scale: 1"=30'
Checked By: CAS	13910 WEST 96th TERRACE LENEXA, KANSAS 66215		Date: 7/23/03
Approved By: EJG			Drawn By: SAG
File Name: FIGURE 6.DWG			Figure No. 6



▽ WATER TABLE ELEVATION DATA COLLECTED 7/3/03

SCREENED PORTION OF MONITORING WELL

DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 7
CROSS SECTION B–B'
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr:	EJG	Terracon	Project No. 02037021
Designed By:	TAR		Scale: 1"=30'
Checked By:	CAS	13910 WEST 96th TERRACE LENEXA, KANSAS 66215	Date: 7/23/03
Approved By:	EJG		Drawn By: SAG
File Name:	FIGURE 7.DWG		Figure No. 7

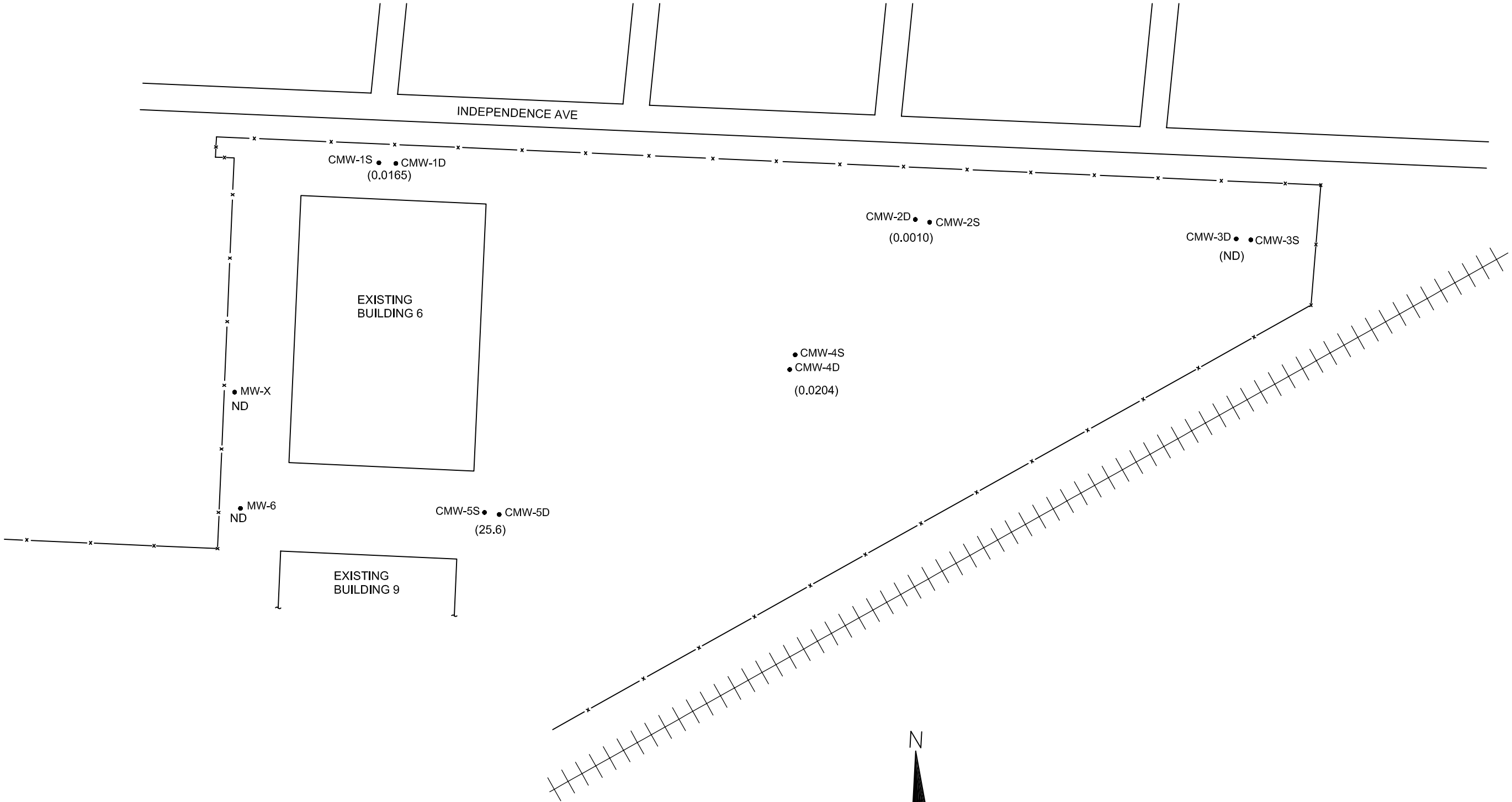


DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 8
SHALLOW GROUNDWATER/ 1,1,2,2 TERACHLOROETHENE (PCA) CONCENTRATIONS (ACTIVE LEVEL 0.0003mg/L)
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr:	EJG	Terracon	Project No. 02037021
Designed By:	TAR		Scale: 1"=80'
Checked By:	CAS	13910 WEST 96th TERRACE LENEXA, KANSAS 66215	Date: 7/28/03
Approved By:	EJG		Drawn By: SAG
File Name:	FIGURE 8.DWG		Figure No. 8

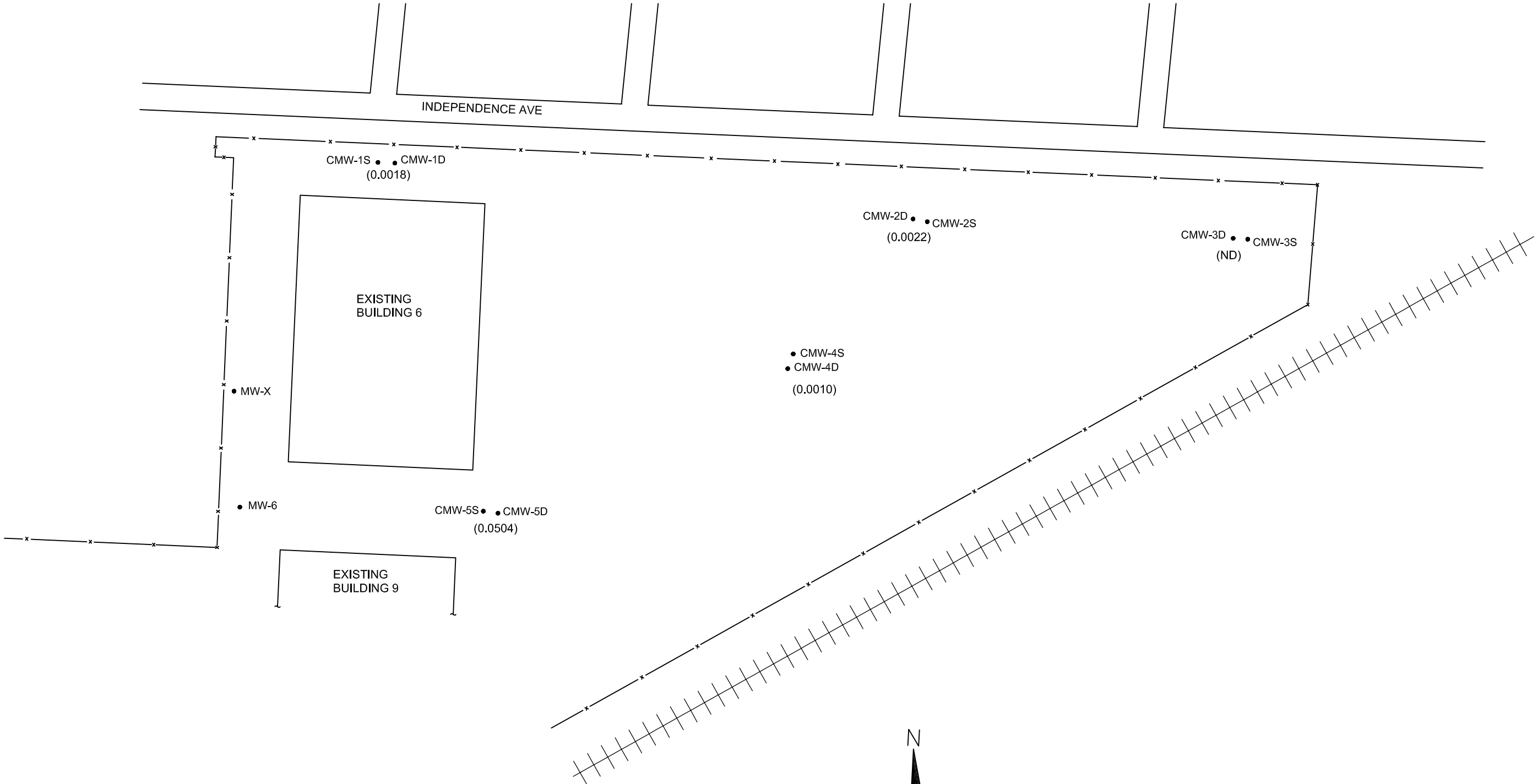


DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 9
DEEP GROUNDWATER/ 1,1,2,2 - TETRACHLOROLETHEN
(PCA) CONCENTRATION (ACTION LEVEL 0.003mg/L)
HARESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr:	EJG	Terracon	Project No. 02037021
Designed By:	TAR		Scale: 1"=80'
Checked By:	CAS	13910 WEST 96th TERRACE LENEXA, KANSAS 66215	Date: 7/28/03
Approved By:	EJG		Drawn By: SAG
File Name:	FIGURE 9.DWG		Figure No. 9

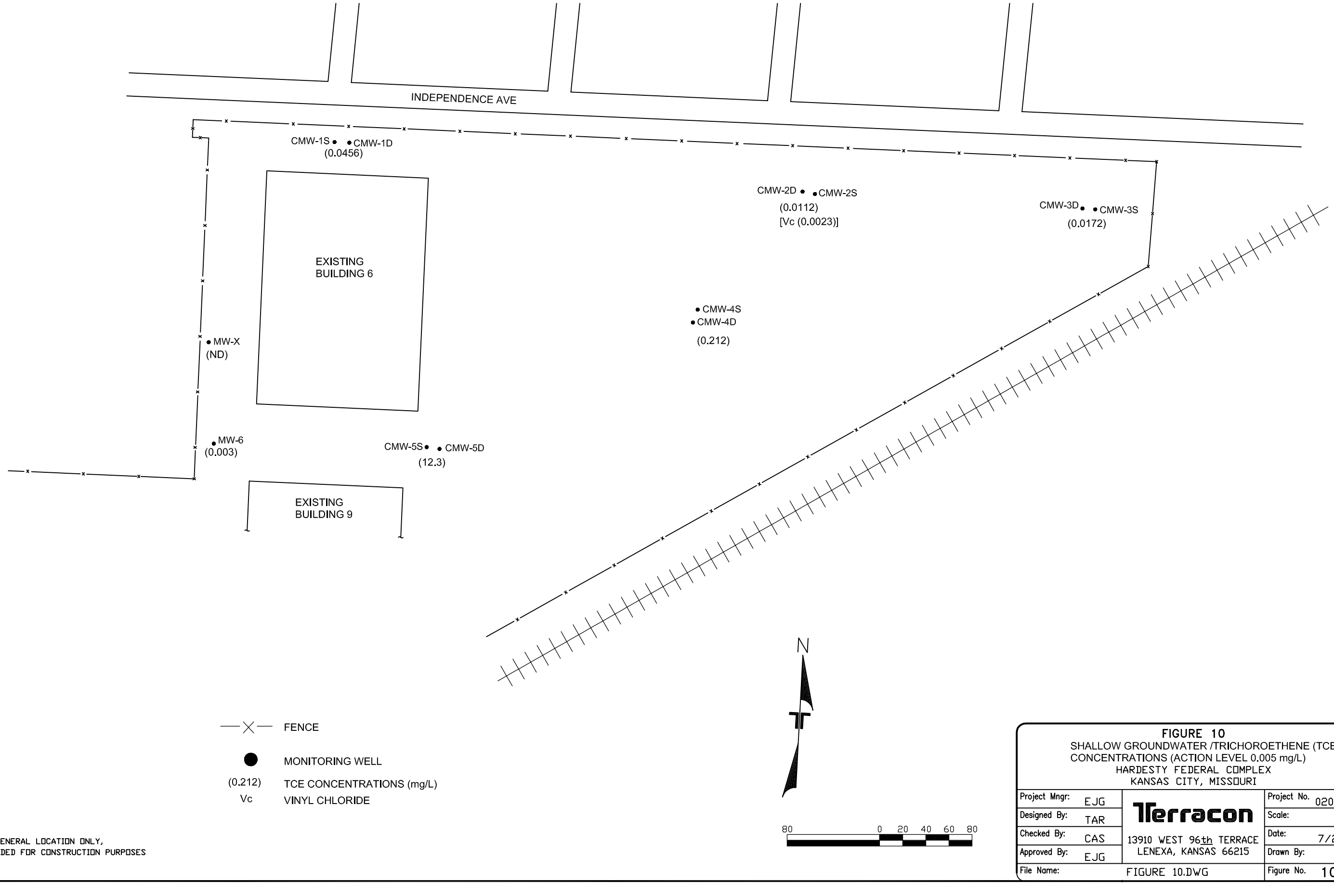


DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 10
SHALLOW GROUNDWATER /TRICHOROETHENE (TCE)
CONCENTRATIONS (ACTION LEVEL 0.005 mg/L)
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr: EJG	Terracon	Project No.	02037021
Designed By: TAR		Scale:	1"=80'
Checked By: CAS	13910 WEST 96th TERRACE LENEXA, KANSAS 66215	Date:	7/28/03
Approved By: EJG		Drawn By:	SAG
File Name: FIGURE 10.DWG		Figure No.	10

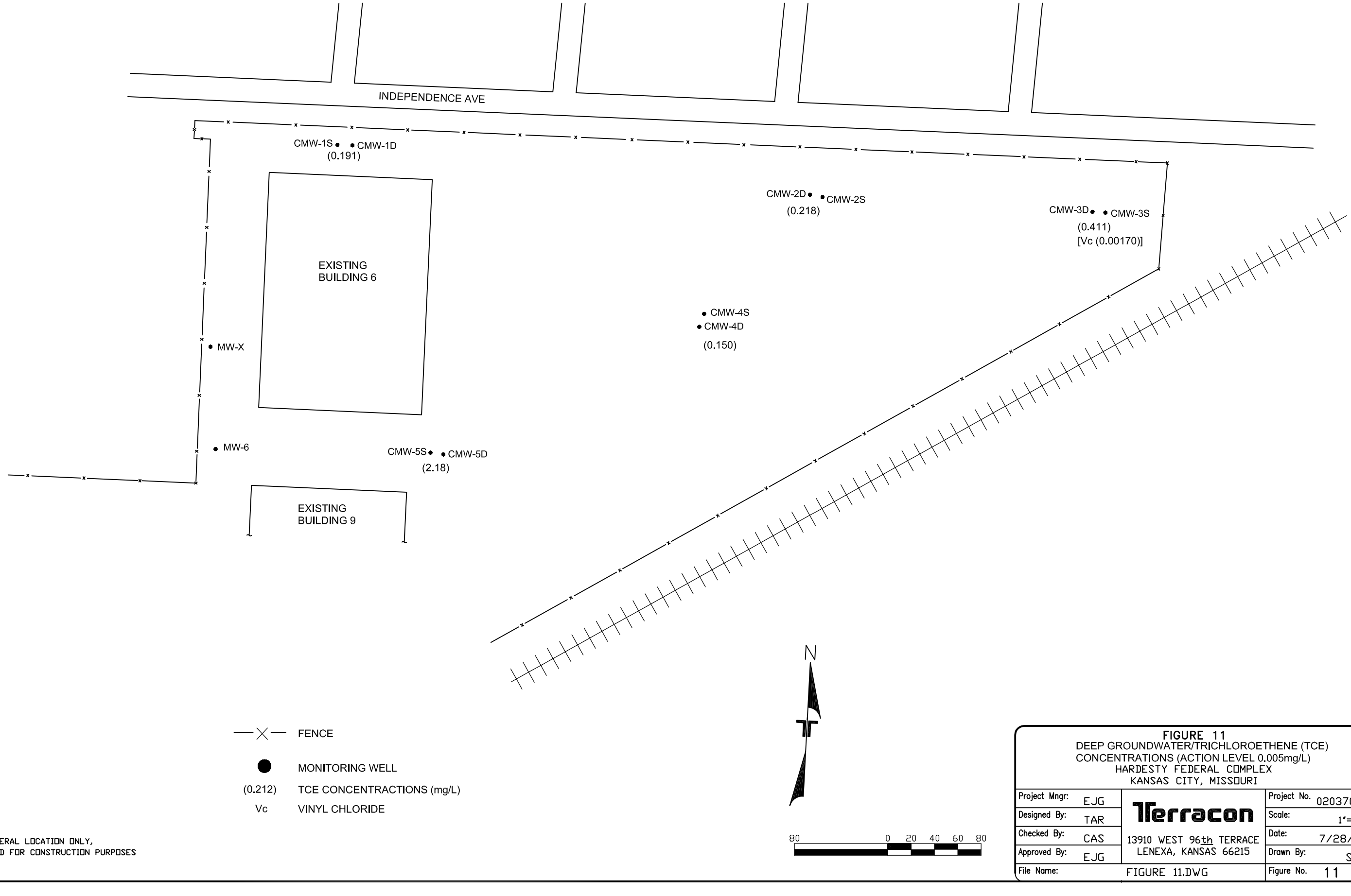


DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 11
DEEP GROUNDWATER/TRICHLOROETHENE (TCE)
CONCENTRATIONS (ACTION LEVEL 0.005mg/L)
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr:	EJG	Terracon	Project No. 02037021
Designed By:	TAR		Scale: 1"=80'
Checked By:	CAS	13910 WEST 96th TERRACE LENEXA, KANSAS 66215	Date: 7/28/03
Approved By:	EJG		Drawn By: SAG
File Name:	FIGURE 11.DWG		Figure No. 11

APPENDIX B

Tables

TABLE 1
Monitoring Well Construction Data
Hardesty Federal Complex

Well ID	Top of Casing Elevation (feet above MSL)	Total Depth (feet)	Bottom of Well Elevation (feet above MSL)	Screen Length (feet)	Top of Screen Elevation (feet above MSL)
CMW 1S (GW)*	788.25	25.00	763.25	15	778.25
CMW 1D (GW)	788.14	83.60	704.54	10	714.54
CMW 2S (GW)	786.49	30.00	756.49	10	766.49
CMW 2D (GW)	786.11	54.80	731.31	15	746.31
CMW 3S (GW)	784.44	29.90	754.54	10	764.54
CMW 3D (GW)	784.23	47.55	736.68	5	741.68
CMW 4S (GW)	786.72	29.90	756.82	10	766.82
CMW 4D (GW)	786.79	60.90	725.89	5	730.89
CMW 5S (GW)	788.42	29.90	758.52	10	768.52
CMW 5D (GW)	788.50	53.10	735.40	5	740.4
MW-6 (GW)	788.42	39.50	748.92	NA	NA
MW X (GW)	788.87	40.00	748.87	NA	NA

* This boring was advacaned to approximately 50 feet below ground surface (bgs); however, due to flowing sands, it was decided to make this well the shallow well for Cluster Monitoring Well (CMW) 1.
NA = Not applicable
MW-6 and MW X were installed by Cape Environmental

TABLE 2
Groundwater Elevation Data
Hardesty Federal Complex

Well ID	Date Measured	Top of Casing Elevation (feet above MSL)	Depth to Water (feet)	Groundwater Elevation (feet above MSL)
CMW 1S (GW)	06/13/03	788.25	20.61	767.64
	07/03/03		14.28	773.97
CMW 1D (GW)	06/13/03	788.14	16.37	771.77
	07/03/03		16.20	771.94
CMW 2S (GW)	06/13/03	786.49	22.34	764.15
	07/03/03		22.38	764.11
CMW 2D (GW)	06/13/03	786.11	19.03	767.08
	07/03/03		18.92	767.19
CMW 3S (GW)	06/13/03	784.44	22.07	762.37
	07/03/03		22.18	762.26
CMW 3D (GW)	06/13/03	784.23	24.85	759.38
	07/03/03		21.45	762.78
CMW 4S (GW)	06/13/03	786.72	19.10	767.62
	07/03/03		19.02	767.70
CMW 4D (GW)	06/13/03	786.79	15.11	771.68
	07/03/03		14.95	771.84
CMW 5S (GW)	06/13/03	788.42	16.68	771.74
	07/03/03		19.28	769.14
CMW 5D (GW)	06/13/03	788.5	16.92	771.58
	07/03/03		16.67	771.83
MW-6 (GW)	06/13/03	788.42	15.88	772.54
	07/03/03		15.77	772.65
MW X (GW)	06/13/03	788.87	12.91	775.96
	07/03/03		13.55	775.32

Note: The groundwater elevation has been adjusted to account for the presence of separate phase product (where applicable).

TABLE 3
SUMMARY OF SOIL ANALYTICAL DATA
HARDESTY FEDERAL COMPLEX
KANSAS CITY, JACKSON COUNTY, MISSOURI

Sample ID (depth in feet)	Sample Date	Associated Monitoring Well	Acetone	Carbon disulfide	Chlorobenzene	Chloroform	cis-1,2-Dichloroethene (cis-1,2-DCE)	trans-1,2-Dichloroethene (trans-1,2-DCE)	Ethylbenzene	Methylene chloride	1,1,1,2-Tetrachloroethane	1,1,2,2-Tetrachloroethane (PCA)	Tetrachloroethene (PCE)	Toluene	1,1,2-Trichloroethane (TCA)	Trichloroethene (TCE)	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Xylenes (Total)
STARC*			**2,700**	**630**	**66**	**0.8**	**1,200**	**2,900**	**400**	**51**	**10**	**2**	**40**	**650**	**5**	**40**	**100**	**42**	**418**
GW Leach**			**none**	**none**	**2.8**	**0.6**	**0.5**	**1.0**	**32**	**0.02**	**0.8**	**0.004**	**0.1**	**3.7**	**0.04**	**0.1**	**none**	**none**	**16**
B1 (10-15)	6/3/03	CMW 1S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0063	0.00270	0.0143
B3 (10-12.3)	6/5/03	CMW 2D	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B4 (28.5-30)^	6/5/03	CMW 2S	ND	0.00780	ND	ND	0.0082	0.0063	0.0025	ND	ND	ND	ND	0.0224	ND	ND	0.0175	0.00540	0.0486
B5 (13.5-15)	6/6/03	CMW 3S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0087	0.00420	ND
B5 (20-25)^	6/6/03	CMW 3S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B7 (2.5-5)	6/9/03	CMW 4S	ND	ND	ND	ND	ND	ND	0.0020	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0119
B7A (15-20)	6/9/03	CMW 4S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0092	ND	ND	ND
B7B (15-20)	6/9/03	CMW 4S	0.0515	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0150	ND	ND	ND
B9 (5-10)	6/10/03	CMW 5S	0.0746	ND	ND	ND	ND	ND	ND	ND	ND	0.0022	ND	ND	ND	0.0116	ND	ND	ND
B9 (25-30)^	6/10/03	CMW 5S	ND	ND	0.0042	0.0075	0.0157	0.0038	ND	ND	0.0293	**50.5**	0.980	ND	0.330	**25.6**	ND	ND	ND
Trip Blank	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rinsate	6/10/03	NA	ND	ND	ND	ND	ND	ND	ND	0.00790	ND	ND	ND	0.0012	ND	ND	ND	ND	ND

Laboratory data source: TestAmerica, Inc.

*Missouri Department of Natural Resources (MDNR) Cleanup Levels For Missouri (CALM) Soil Target Concentrations (STARC), Scenario A, dated September 1, 2001.

**MDNR CALM Leaching to Groundwater Values, dated September 1, 2001.

^Samples collected below established groundwater level.

Notes:

1) All soil concentrations reported in milligrams/kilogram (mg/kg) (same as parts per million (ppm)).

2) ND = not detected above the reporting limit in mg/kg (ppm) as noted in the laboratory analytical report.

3) Gray shaded bold cells indicate levels above MDNR CALM STARC, Scenario A, or GW Leach.

4) Not established (NE).

5) NA = not applicable.

TABLE 4
SUMMARY OF GROUNDWATER ANALYTICAL DATA
HARDESTY FEDERAL COMPLEX
KANSAS CITY, JACKSON COUNTY, MISSOURI

Sample ID	Sample Date	Acetone	sec-Butylbenzene	Chlorobenzene	Chloroform	1,2-Dichlorobenzene	1,2-Dichloroethane (1,2-DCA)	1,1-Dichloroethene	cis-1,2-Dichloroethene (cis-1,2-DCE)	trans-1,2-Dichloroethene (trans-1,2-DCE)	1,1,1,2-Tetrachloroethane	1,1,2,2-Tetrachloroethane (PCA)	Tetrachloroethene (PCE)	1,1,1-Trichloroethane	1,1,2-Trichloroethane (TCA)	Trichloroethene (TCE)	Vinyl Chloride
GTARC*		**None**	**NE**	**0.1**	**0.08**	**0.6**	**0.005**	**0.007**	**0.07**	**0.1**	**0.07**	**0.0003**	**0.005**	**0.2**	**0.005**	**0.005**	**0.002**
CMW 1S	6/14/03	ND**	ND	ND	ND	ND	ND	ND	0.00440	0.00260	ND	**0.0165**	0.00200	ND	ND	**0.0456**	ND
CMW 1D	6/14/03	ND**	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.00180**	ND	ND	ND	**0.0191**	ND
CMW 2S	6/14/03	ND**	ND	ND	ND	ND	ND	ND	0.0568	0.0484	ND	**0.00100**	ND	ND	ND	**0.0112**	**0.00230**
CMW 2D	6/14/03	ND**	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.00220**	0.00270	ND	0.00120	**0.218**	ND
CMW 3S	6/14/03	ND**	ND	ND	ND	ND	ND	ND	0.0284	0.00230	ND	ND	ND	ND	ND	**0.0172**	ND
CMW 3D	6/14/03	ND**	ND	ND	ND	ND	ND	ND	0.00240	ND	ND	ND	ND	ND	ND	**0.411**	0.00170
CMW 4S	6/14/03	ND**	ND	ND	0.00140	ND	ND	ND	ND	ND	ND	**0.0204**	0.00450	ND	0.00110	**0.212**	ND
CMW 4D	6/14/03	ND**	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.00100**	0.00200	ND	ND	**0.150**	ND
CMW 5S	6/14/03	0.0304	ND	0.00650	0.0133	ND	0.00120	**0.0434**	0.0689	0.0216	0.0354	**25.6**	**0.692**	0.110	**0.198**	**12.3**	ND
CMW 5D	6/14/03	ND**	ND	ND	ND	ND	ND	ND	0.00250	ND	ND	**0.0504**	**0.0526**	ND	**0.0107**	**2.18**	ND
MW-6	6/14/03	ND**	0.00480	ND	ND	0.00440	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW X	6/14/03	ND**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00370	ND
Duplicate (a)	6/14/03	ND**	ND	ND	ND	ND	ND	ND	0.00260	ND	ND	**0.0548**	**0.0529**	ND	**0.0111**	**1.75**	ND
Trip Blank	6/14/03	ND**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Blank	6/14/03	ND**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Laboratory data source: TestAmerica, Inc.

*Missouri Department of Natural Resources (MDNR) Cleanup Levels For Missouri (CALM) Groundwater Target Concentrations (GTARC), dated September 1, 2001.

(a) Duplicate of CMW-5D

Notes:

1) All groundwater concentrations reported in milligrams/liter (mg/l) (same as parts per million (ppm)).

2) ND = not detected above the reporting limit of 0.00100 mg/l (ppm).

3) ND** = not detected above the reporting limit of 0.0250 mg/l (ppm).

4) Gray shaded bold cells indicate levels above MDNR CALM GTARC.

5) Not established (NE).

APPENDIX C

Boring Logs

APPENDIX D

Laboratory Reports and Associated Chain of Custody Forms